Lesson Structure

- Lesson 1&2 – Heat and Temperature
  - Cooling curve experiment
  - Cooling Curve Graph
- Lesson 3&4 – Conduction
  - Conduction with Vaseline and paper clips experiment
  - Conduction with different metals experiment
- Lesson 5&6 – Convection
  - Convection Tube Demonstration
  - Convection in a beaker experiment
  - Colour Convection Current Demonstration (optional)
- Lesson 7 – Radiation
  - Leslie's cube demonstration
  - Infrared camera
- Lesson 8&9 – Preventing Heat Loss
  - Preventing heat loss experiment

Starter

1. Name 3 sources of heat.

2. State the piece of equipment used to measure temperature

Learning Intentions:

- To learn about heat and temperature and how they are measured
- To undertake an experiment measuring the temperature cooling curve of water

Tick me at the end if ***you can*** …

Success Criteria

- ☐ I can state the definitions of heat and temperature
- ☐ I can identify the units that heat and temperature are measured in

We depend on heat in our home!

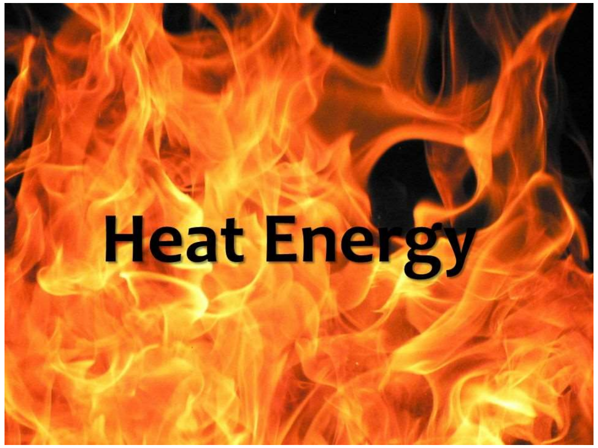
What is temperature?

- Temperature tells us how hot or cold an object is
- A thermometer measures temperature
- Temperature is measured in degrees Celsius (°C)

Anders Celsius (1701 – 1744)

What is heat?

- Heat (like light) is a form of <u>energy.</u>
- All energy is measured in Joules (named after James Joule.)



James Joule
(1818 – 1889)

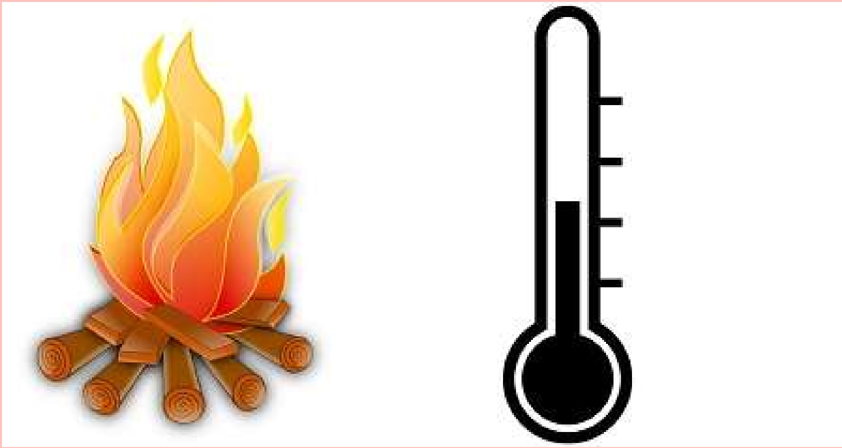
Heat and Temperature

24/09/2024

Page 2

Heat is a type of ___**energy**_____, measured in ___**joules**_____.

Temperature is measured using a ___**thermometer**___ and tells us how hot or cold something is.



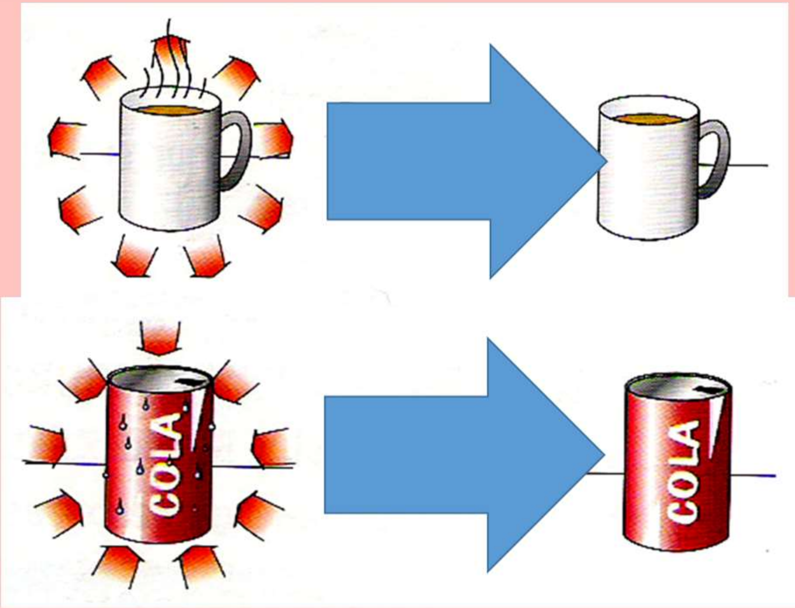
HEAT TEMPERATURE

Scenario 1: You have just poured a cup of hot coffee!

What happens to the temperature over time?
Explain why?

Scenario 2: You have just taken a cold can of cola from the fridge.

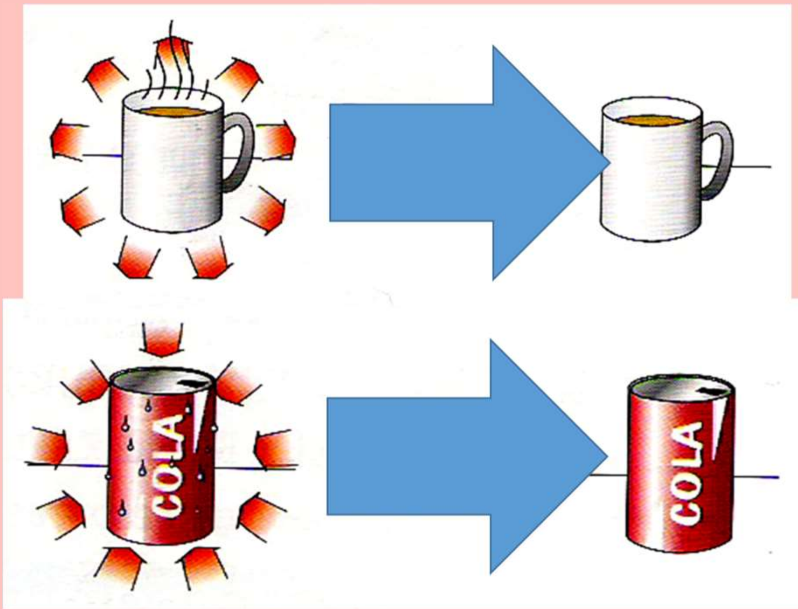
What happens to the temperature over time?
Explain why?



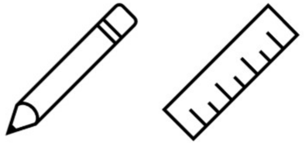
Heat and Temperature

Page 3

Heat energy is transferred from the __**hot**__ object to the __**cold**__ object.



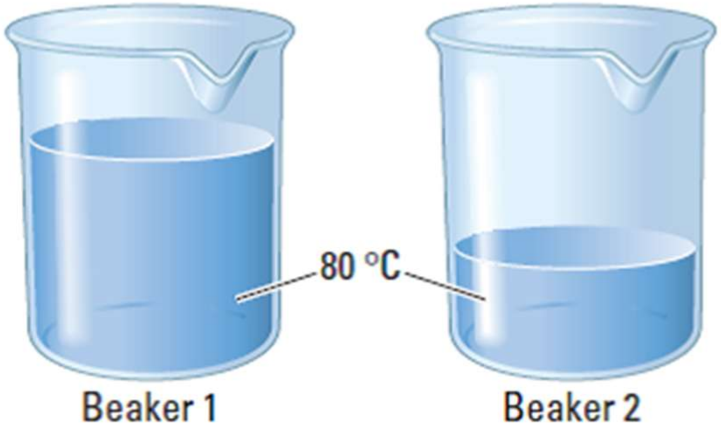
Cooling curve experiment



Aim: To investigate which beaker of water loses heat most quickly

Method:

- Collect two 400 ml beakers.
- Add 300 ml of hot water to beaker 1.
- Add 100 ml of hot water to beaker 2.



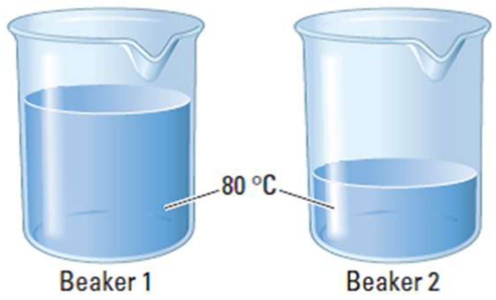
Results:

Time (mins)	Beaker 1 (°C)	Beaker 2 (°C)
0		
1		
…….. Up to 15 mins		

Cooling curve experiment

Aim: To find out which beaker of water looses heat most quickly

Method: Add 300 ml of hot water to a 400ml beaker and 100 ml of hot water to a 400ml beaker and record the temperature every 1 minute for 15 minutes.



Results: *Draw a table for your results with headings and units.*
Draw a graph of your results.

Conclusion: *What is the answer to your aim?*

Evaluation: *How could you improve your experiment?*

Plenary

Page 27

- Go to **page 27**.
- Summarise what you have learned in the table by:
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    - What did you learn?
    - Did what you learn change the way you think?

  - Comment on any real-world applications you can use for this information

Lesson	Key Concepts Learned	Real-World Applications
Heat and Temperature		
Heat Transfer Scenarios		

Heat and Temperature

24/09/2024

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Learning Intentions:

- To learn about heat and temperature and how they are measured
- To undertake an experiment measuring the temperature cooling curve of water

Tick me at the end if ***you can*** …

Success Criteria

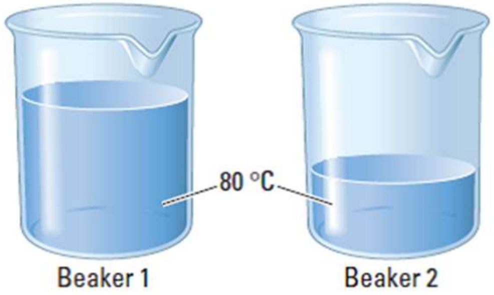
☐ I can state the definitions of heat and temperature

☐ I can identify the units that heat and temperature are measured in

Cooling curve experiment

Aim: To find out which beaker of water looses heat most quickly

Method:

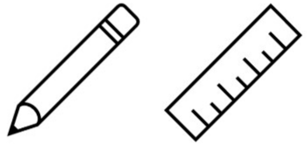


Results: *Draw a table for your results with headings and units.*
Draw a graph of your results.

Conclusion: *What is the answer to your aim?*

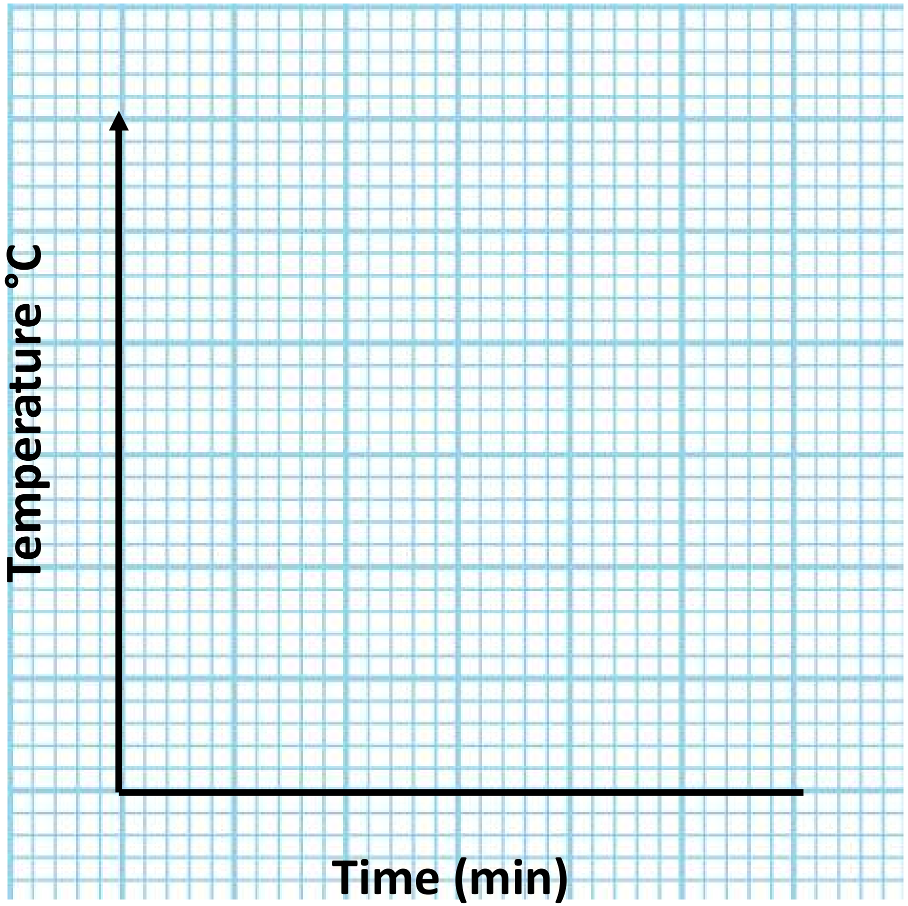
Evaluation: *How could you improve your experiment?*

Graph: Cooling curve



Plot 2 curves

- 300 ml water
- 100 ml water



Plenary

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Lesson	Key Concepts Learned	Real-World Applications
Cooling Curve Experiment		

Conduction

24/09/2024

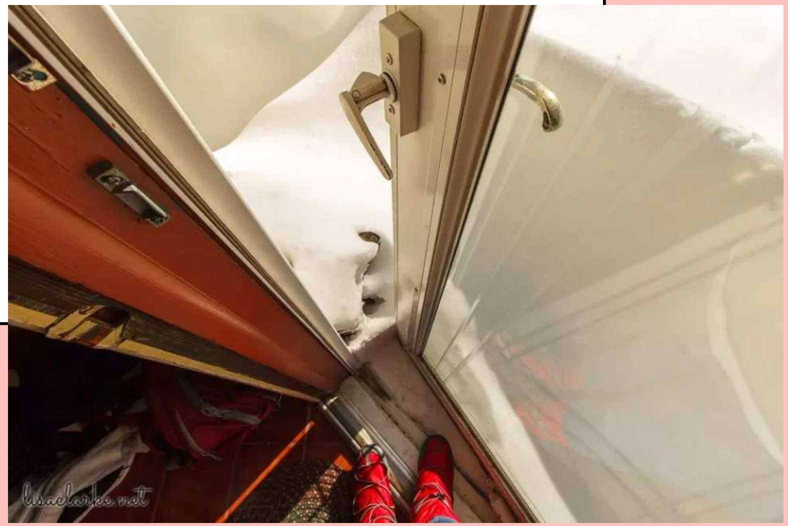
Page 6

Starter

1. You may hear someone say

   ‘shut the door, you’re letting the cold in!!!’

   Explain why are they wrong?



Conduction

24/09/2024

Page 6

Learning Intentions:

- To learn about heat and temperature and how they are measured
- To undertake an experiment measuring the temperature cooling curve of water

Tick me at the end if ***you can*** …

Success Criteria

- ☐ I can complete a scientific report.
- ☐ I can identify good conductors and insulators

Conduction

24/09/2024

Page 6

Which of these in your kitchen are good conductors of heat?

Conduction

Page 6

What spoon feels colder?
Explain why?

Conduction

What spoon feels colder?
Explain why?

Answer: Metal conducts the heat away from your hands. Plastic does not conduct the heat away from your hands as well as the metal, so the metal feels colder than the plastic.

Heat Travelling in Solids

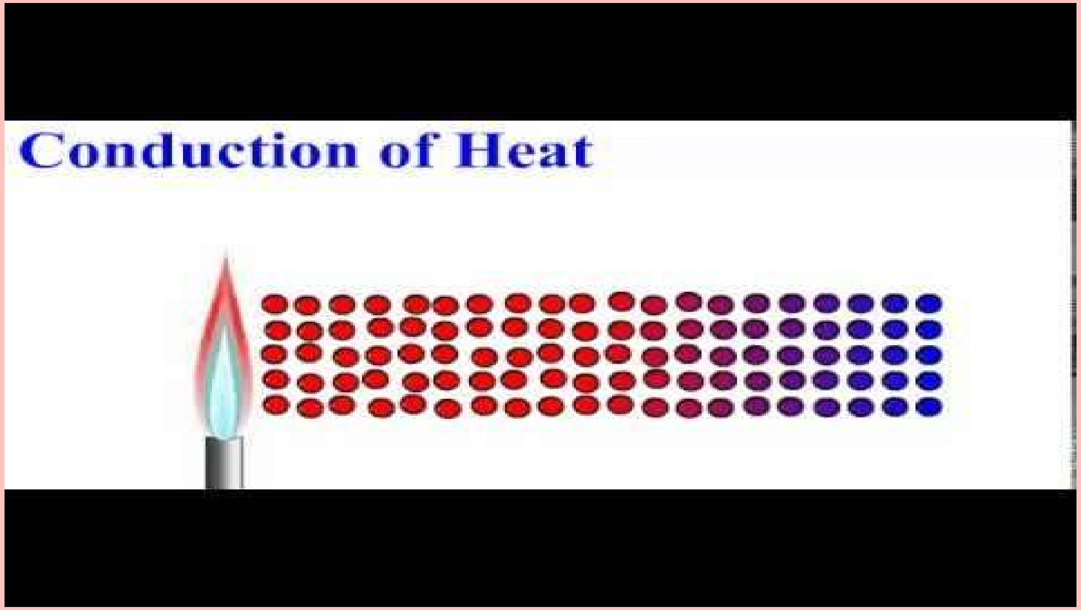
A conductor is a material that allows the __transmission__ of heat.

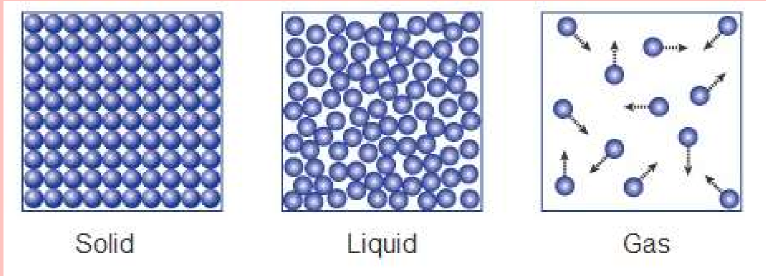
Poor conductors of heat are called __insulators__.

Conduction

24/09/2024

Why do only solids conduct heat well?



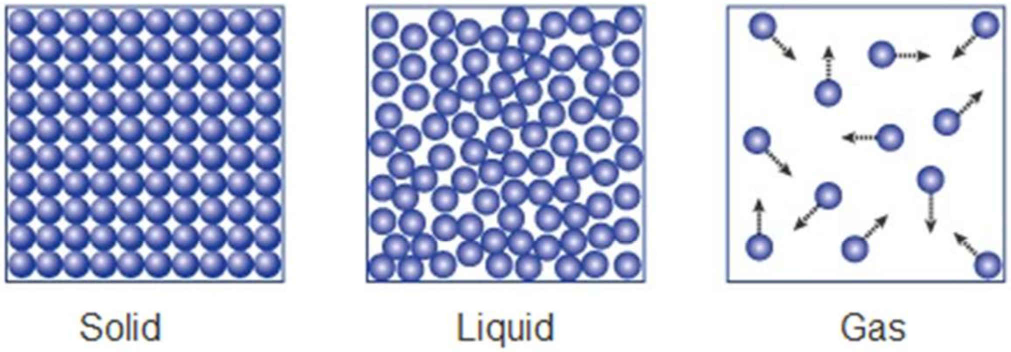


Why do only solids conduct heat?

Conductivity is caused by the ___vibration___ of ___particles___.

The vibrating particles vibrate into the particles ___close___ to them which ___transfers___ the heat energy.

So, why do only solids conduct well?



Particles are **close** → Particles are **far-apart**

Conduction

24/09/2024

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Heat travelling in solids

Activity

Fill in the table with appropriate headings and decide if each of the following are **conductors** or **insulators:**

Wooden spoon, aluminium pot, glass, plastic cup, metal fork, oven gloves, tiles, leather, coins

Good Conductors of Heat

Aim: To investigate which metal is the best conductor of heat.

Method: *draw a labelled diagram*

Results:

Metal	Time for heat to travel (s)
Aluminium	
Brass	
Copper	
Steel	

Conclusion: *what is the answer to your aim?*

Evaluation: did you carry out a fair test? Is there anything else that you could have done differently, to improve the reliability of your conclusion?

Plenary

Page 27

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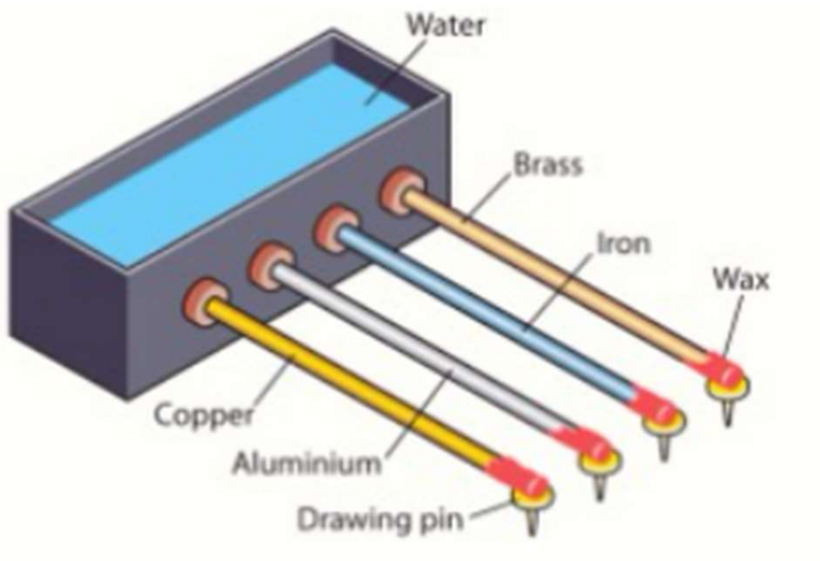
Lesson	Key Concepts Learned	Real-World Applications
Conduction		

Predict observations (optional demonstration)



From your experiment results and from the results of the demonstration last lesson, ***predict*** what you think will happen in the experiment above.

Convection of liquids

24/09/2024

Page 9

Starter

1. Draw the particles in a liquid.

2. Why do you think heat cannot travel through liquids by conduction? (*hint:* think of the particles)

3. List 3 different liquids in your home that heat can travel through.

Convection of liquids

24/09/2024

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Learning Intentions:

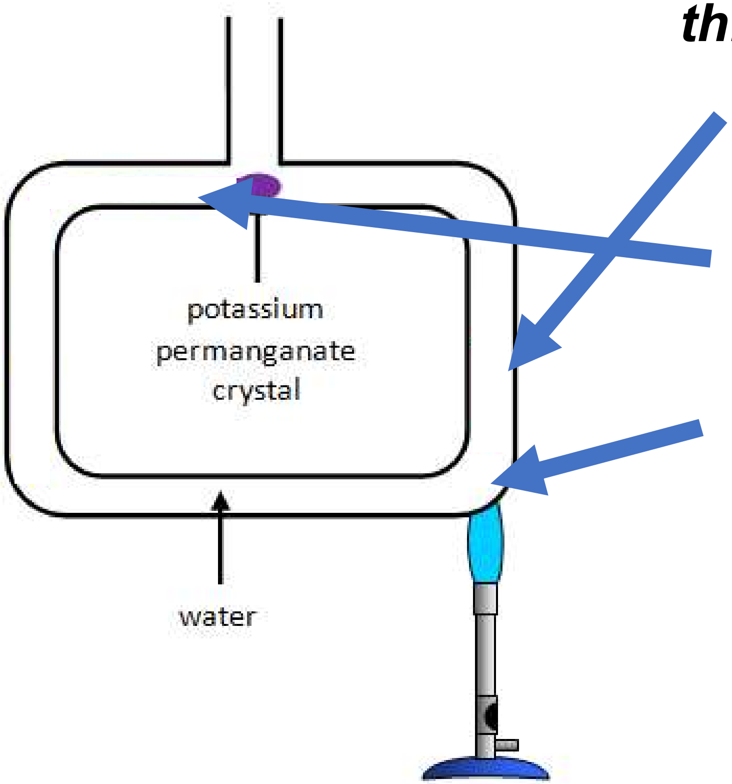
- To learn how heat travels through liquids

Tick me at the end if ***you can*** …

Success Criteria

- ☐ I can complete a scientific report
- ☐ I can state the term used for heat travelling through liquids
- ☐ I can explain how heat travels through liquids

Convection of Liquids (demonstration)



While watching the demonstration, *think* about the following questions:

1. What direction does the water move above the Bunsen burner?
2. What direction does the potassium permanganate move?
3. How did the glass feel just above the Bunsen burner when we stop heating it?
4. **Explain** why it feels this way.

Convection of liquids

24/09/2024

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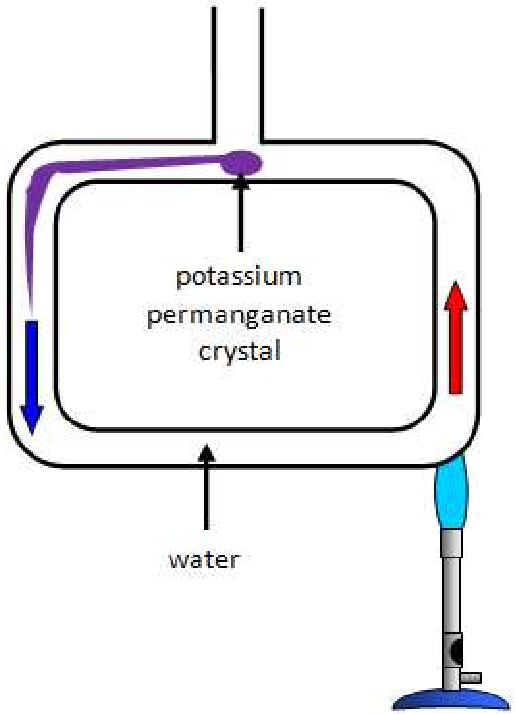
Convection



Heat is not transferred in liquids by ___**conduction**_______. As the particles are too close together in a solid to move.

In a liquid heat is transferred by _**convection**___. A _**convection**_ current is formed.

Video of convection currents in liquids

Colour Convection Current Demo

Convection current instructions and video

Convection of Ocean Currents (optional)

Video

Questions

- Summarise what you learned in this video in your workbook.
- Why do you think this is relevant in the ocean, what effect do you think convections currents have in the ocean?

Plenary

Page 27

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  - Comment on any real-world applications you can use for this information

Lesson	Key Concepts Learned	Real-World Applications
Convection in Liquids and Gases		

Convection of gases

24/09/2024

Starter

1. Draw the particles in a gas

2. When you boil a kettle a convection current is formed. Draw a diagram of how this would look.

Convection of gases

24/09/2024

Learning Intentions:

- To learn how heat travels through gases

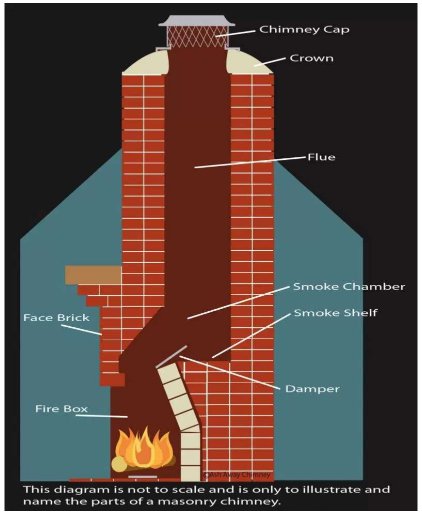
Success Criteria

- ☐ I can complete a scientific report
- ☐ I can explain how heat travels through gases

Convection of gases

24/09/2024

Convection Air Demonstration



Draw and label a diagram, draw arrows to show your <u>observations.</u>

<u>Challenge yourself:</u> **Explain** how a coal fire chimney works.

Watch the video and rate your own explanation out of 5

Convection of gases

24/09/2024

Convection

Convection happens in a __liquid__ and a __gas__.

When the particles get hot they gain __energy__.

The particles with the most __energy__ move upwards.

When the particles cool down they move __downwards__ to be heated again until all particles are the same temperature.

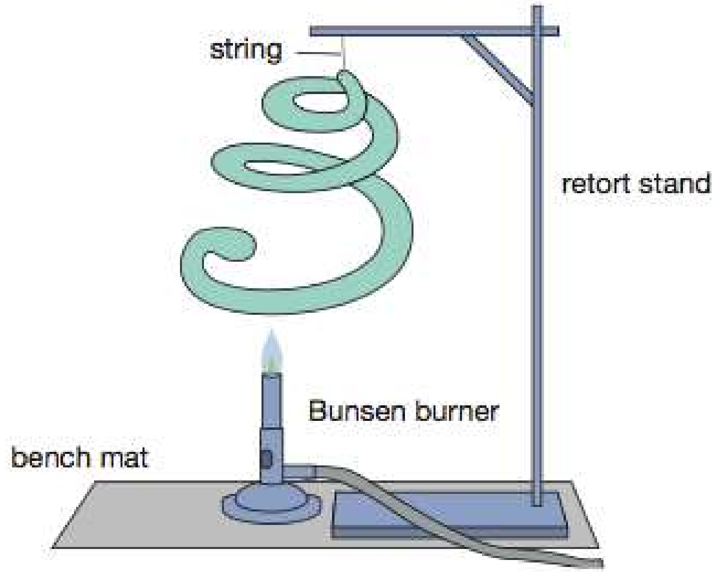
Convection video

Optional: Air Convection Experiment

Aim: To find out how heat moves through gases

Draw and label a diagram, explain your observations.

Explain why particles in a gas can form a convection current and particles in a solid cannot?



Plenary

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Convection in Liquids and Gases		

Radiation

24/09/2024

Page 14

Starter

1. Why is toasting your bread on the grill not an example of conduction?

2. Why is toasting your bread on the grill not an example of convection?

3. What do you understand by the word ‘radiation’?

Learning Intentions:

- To learn how heat travels through radiation

Success Criteria

- ☐ I can complete a scientific report
- ☐ I can state which heat transfer method the sun uses
- ☐ I can explain how heat travels by radiation

What is radiation

Heat can be transferred through radiation.

Radiation does not rely on particles.

Some surfaces are better than others at **absorbing** (taking in) radiation. Some surfaces **reflect** heat.

Do you feel warmer in the sun wearing black or white?

Can you explain why this is?

Radiation Experiment

Aim: To investigate the effect of shiny and black surfaces on the amount of radiation radiated.

Method: *Draw your method in the space provided*

Results:

Time (mins)	Temperature of water of shiny can (°C)	Temperature of water of matt black can (°C)
1		
2		
3		

Radiation

Why do you think these objects are silver and shiny?

We know that silvery shiny materials keep **heat** in. The flask **could reflect** the heat towards the hot drink, the space blanket could reflect the body **heat** back toward the wearer.

Results:

Time (mins)	Temperature of water of shiny can (°C)	Temperature of water of matt black can (°C)
1		
2		
3		

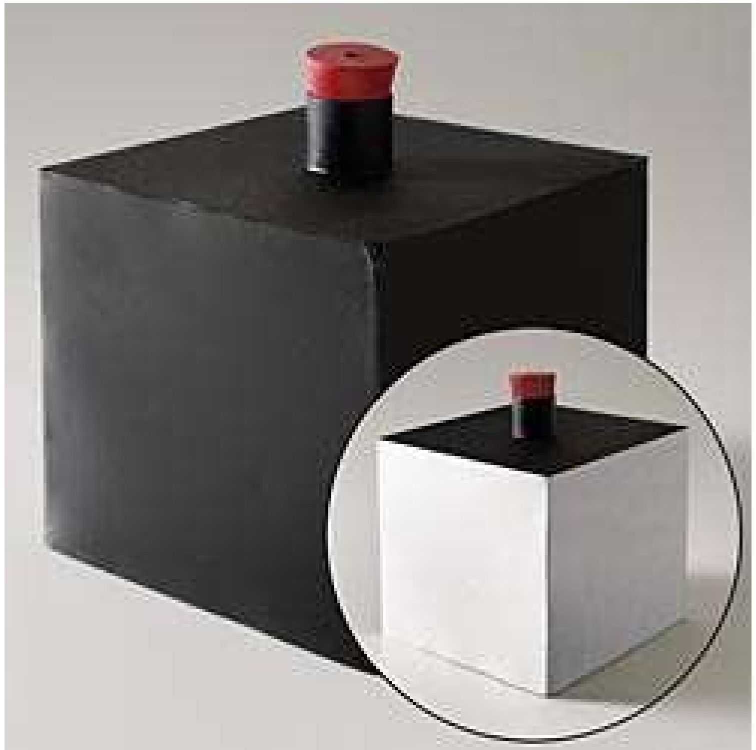
Draw a graph of your results

Conclusion: *What is the answer to your aim?*

Evaluation – how could we improve our experiment?

Leslie's cube demo:

- infrared thermometer
- Leslie's cube
- kettle for filling cube with hot water



Radiation

24/09/2024

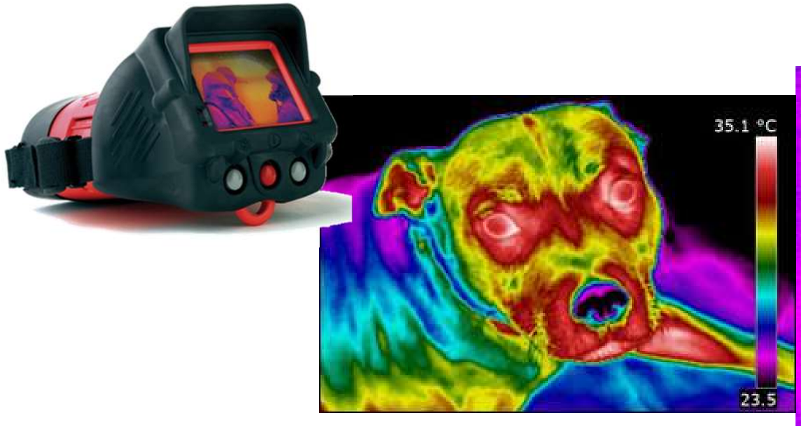
Link to throwing hot and cold balloons

Link to NASA website

Radiation is also known as **Infrared radiation** (this is invisible) which is a type of **light**.

The **hotter** an object is, the **more** infrared radiation it emits.

You can see infrared radiation using **thermal imaging cameras**.



Thermal imaging camera

- Summarise by writing or drawing what you seen with the Infrared camera (what was cold, what was hot ...)

Plenary

Page 27

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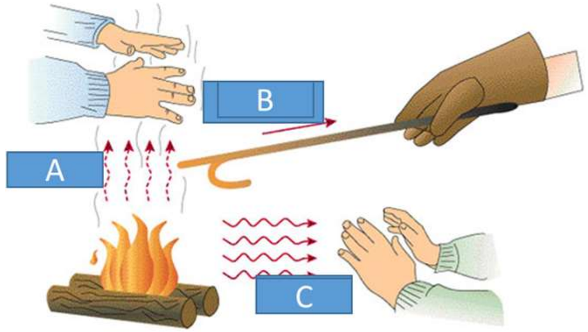
Lesson	Key Concepts Learned	Real-World Applications
Radiation		

Preventing heat loss

24/09/2024

Starter

1. Label the heat transfer method in A,B and C.



2. Explain how the infra-red photo shows where most of the heat energy is escaping from.

Preventing heat loss

24/09/2024

Learning Intentions:

- To learn about reducing heat loss in our home

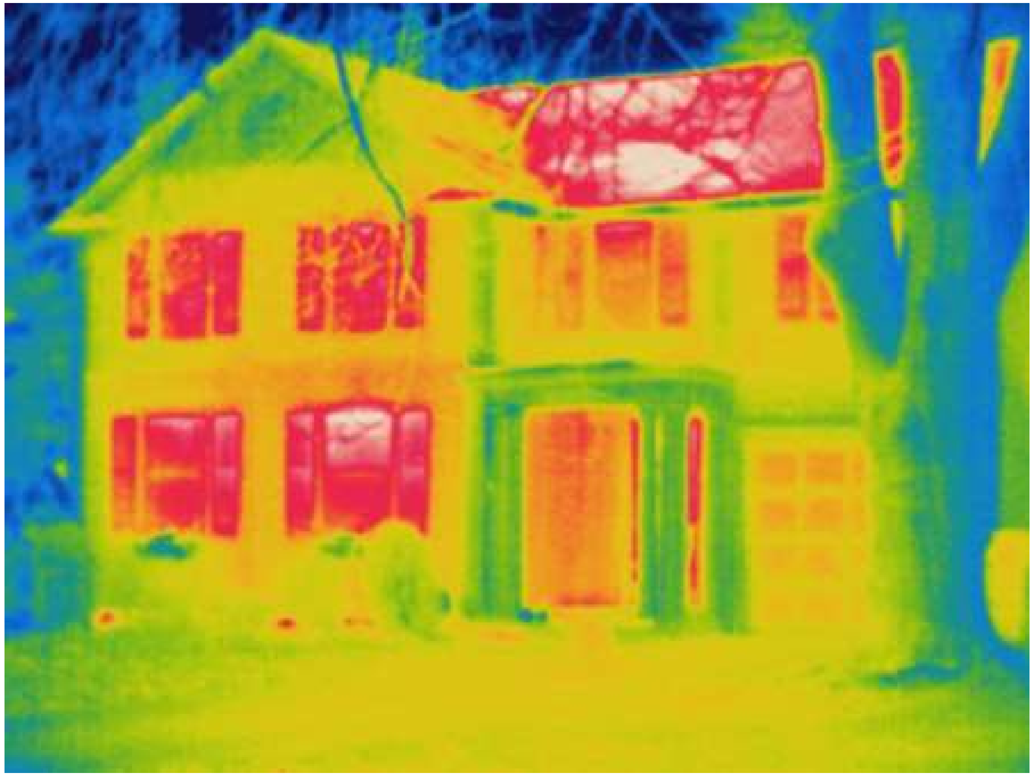
Success Criteria

☐ I can identify ways of reducing heat loss in a home

☐ I can interpret thermal imaging diagrams

Preventing heat loss

24/09/2024



This is an image showing heat loss from a house. Where is the most heat loss?

Preventing heat loss 24/09/2024

Insulators

Insulators are substances that **do not readily** transfer heat.

Air is an excellent heat **insulator** and helps to stop heat loss

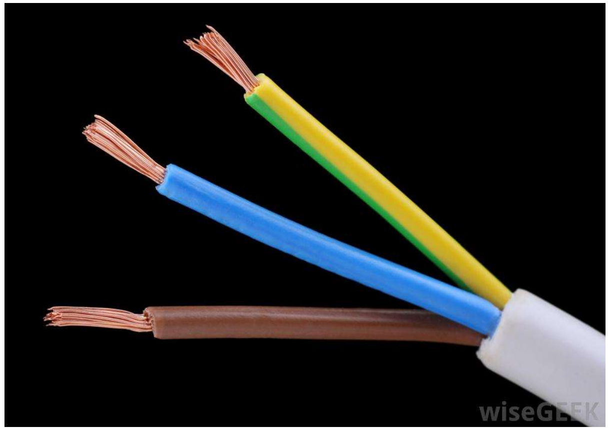
Your body is **warmer** than the air around you and so it is always **losing** heat.

From the video clip how do polar bears keep warm in the arctic?

Video- Davina McCall
Life at extreme
(taken down?)

Insulators at home

Why are these good insulators?



Insulators

Why are these good insulators?

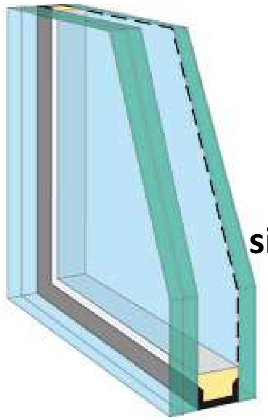
- What do these things have in common?
  - Polystyrene drinks cups,
  - sleeping bags,
  - birds fluffed-up feathers,
  - double glazed windows,
  - fleece jackets

- They are made with materials with trapped air in them – but why?

Preventing heat loss

24/09/2024

Birds fluff up their feathers to trap air to keep warm



Double glazed windows have air trapped in side to keep the house warm

Sleeping bags have fibres with air trapped between them

What have these all got in common to reduce heat loss?

Materials with trapped air in them are good insulators

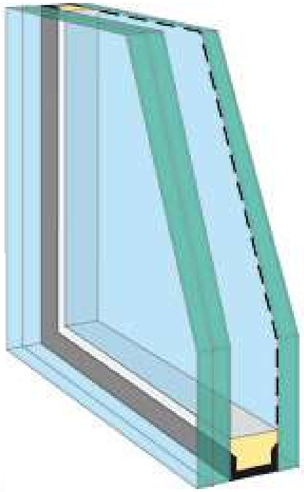
Polystyrene cups have lots of bubbles of air to keep drinks hot or cold

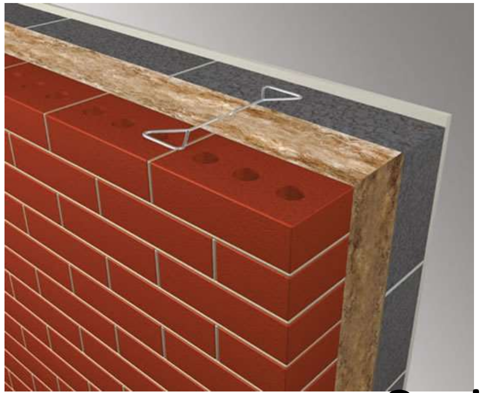
warm jackets have a lot of trapped air between its fibres

What are ways to reduce heat loss in the home?

Draught Excluder

Double Glazing





Cavity Walls

Loft Insulation

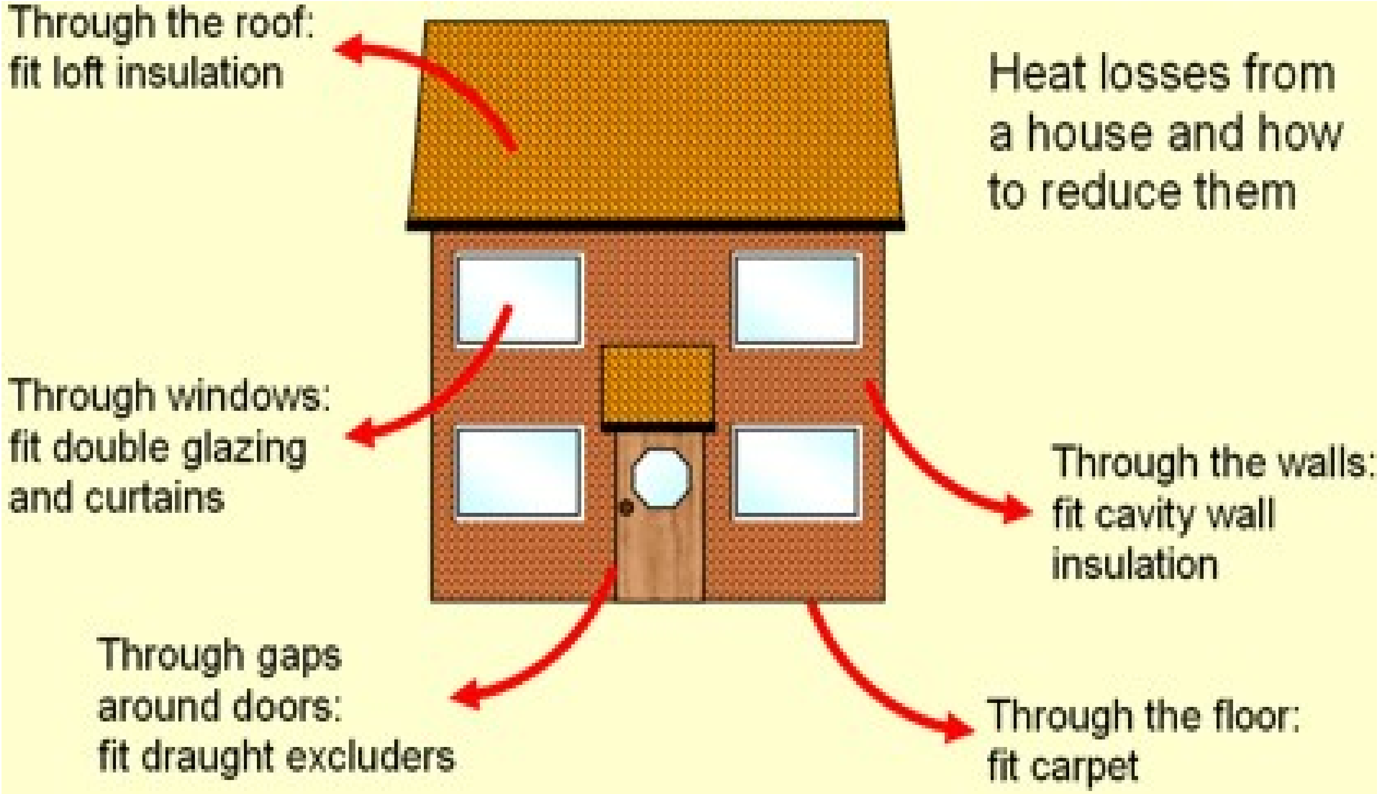
Carpets

Preventing heat loss

24/09/2024

For each of these, has conduction, convection or radiation been reduced?

Reducing heat loss



Reducing heat loss

List how heat is reduced in a home in the table, explain how this prevents heat escaping and then state the type of heat transfer involved

What	How	Heat Transfer
Paint radiators black	*Black surfaces emit more heat than shiny surfaces*	*Radiation*

Video – reducing heat loss

https://www.youtube.com/watch?time_continue=1&v=50VB2p0osbE

(an architect describes how her knowledge of physics helps her to design energy efficient buildings and summarises conduction, convection and radiation – 6 minutes)

Video – reducing heat loss

https://www.youtube.com/watch?time_continue=1&v=50VB2p0osbE

(an architect describes how her knowledge of physics helps her to design energy efficient buildings and summarises conduction, convection and radiation – 6 minutes)

Preventing heat loss

24/09/2024

Draw lines to match the description

Temperature
Thermometer
Particles in a Gas
Particles in a Liquid
Particles in a Solid
Conductor
Insulator
Heat
3 ways heat energy can be transferred

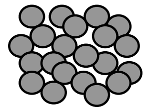
Heat energy can easily pass through this material

Convection

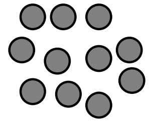
A device used to measure temperature

How hot or cold something is

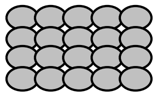
Conduction



Radiation



Heat energy cannot easily pass through this material



A measure of energy

Plenary

Page 27

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Lesson	Key Concepts Learned	Real-World Applications
Preventing Heat Loss		

Preventing heat loss challenge

24/09/2024

Learning Intentions:

- design an experiment to prevent heat loss

Success Criteria

□ I can design a system that will reduce the loss of heat successfully

Preventing heat loss challenge

24/09/2024

Task

You will design, write-up and carry out an experiment to devise a way of **keeping 100 ml of hot water as hot as possible.**

i.e. keep the heat lost to a minimum

The resources available are:

Containers – metal, glass, plastic

Materials – cloth, bubble wrap, polystyrene, black card, aluminium foil, cotton wool

To be able to compare how well your set-up has worked, you should set up a control experiment (with no heat loss reduction)

Preventing heat loss challenge

24/09/2024

Preventing Heat Loss

- Aim: To devise a way of keeping 100 ml of hot water as hot as possible.
- Method: A drawing of your method with all materials used labeled
- Results: What was your initial temperature and temperature after 5 mins for your control and heat-loss reduction set up?
- Conclusion: How well did your set up reduce heat-loss?

Preventing heat loss challenge

24/09/2024

Success criteria: Which group's 100 ml hot water has retained the most heat (or lost the least heat) in 5 minutes?

How could you display the class results?

Starter

Heat energy is also known as a type of electromagnetic radiation, what is this called?